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# TECHNICAL ASSISTANCE REPORT

# BIG COULEE AREA —
PROPOSED RURAL DOMESTIC WATER SYSTEM

Prepared By:

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## Introduction

The Water Development Bureau of the Department of Natural Resources and Conservation was informed of the domestic water supply problem in the Big Coulee Area south of Ryegate, Montana at a meeting of the residents of the area on June 16, 1976. Those attending were informed of the Technical Assistance Program for water resource projects. They felt it would be beneficial to have the Bureau conduct a prefeasibility study for a rural domestic water supply system for the Big Coulee area. Residents of the area haul water for human consumption. They have wells of poor quality or collect rainwater for washing dishes, clothes, etc. and for watering lawns and gardens. The geologic formation where the residences are located is such that good quality water is very expensive if not impossible to obtain by drilling.

As a result of the meeting, Musselshell-Golden Valley County Extension Agent, Darryld Kautzmann forwarded water-use information and a location map of potential users to the Bureau. On August 25, 1976, Bureau personnel ran a preliminary survey to establish approximate location and elevation of the potential users listed on the location map. This data was used to determine sizes and lengths of pipe required to deliver 15 gallons per minute at a minimum pressure of 50 pounds per square inch to each of the 12 users. The Bureau contacted several firms for current prices on individual sections of the system. These prices have been applied to the items included in Table 1.

The Bureau prepared a financial analysis of the system based on 5% interest and a 40 year repayment period. From this, a monthly rate based on 12 users was calculated.

Alternatives include: (1) maintaining the present method of obtaining water; (2) development of a centralized rural water system as discussed in this report; (3) development of the well as proposed and deliver water with a tank truck, or (4) pruchase a tank truck and deliver water from Ryegate to individual cisterns. Each alternative is assessed later in this report.

## Engineering Information

The location of the proposed well for this study is in the middle of Section 32, Township 6 North, Range 20 East, approximately six miles south of Ryegate, Montana. An exact well site will have to be determined by a geologist or other knowledgeable groundwater expert and by drilling test holes.

Geological maps of the area show three main geological formations in the immediate Big Coulee Area. The upper formation is the Claggett, followed by the Eagle and then the Colorado. The Claggett is generally a poor producer of water, however, well logs of the area show three flowing wells at about 200 feet and several springs. These are located about seven miles east and three miles north of the proposed site. The Eagle is a sandstone formation and generally a good producer of water. This formation exists on both the north and south benches above the coulee and is the one in which the proposed well would be drilled. The base of the coulee is a

Colorado Shale formation which is relatively thick, it is a poor producer of water, and the water quality is generally poor. This is the reason for the domestic water supply problem in Big Coulee. The best possibility for water relative to the area of interest is the Eagle formation.

From well logs of the area we were able to pick an approximate location and to estimate a well depth and yield. We assumed a well depth for cost estimation puproses of 120 feet and a flow rate of 20 gallons per minute. At this flow rate, each user would be limited to 2,400 gallons per day. The flow rate would supply adequate water for an average family of four at 70 gallons per day, 2,000 square feet of lawn and garden at 110 gallons each per day, two milk cows at 15 gallons each and 150 head of additional livestock at 1,800 gallons per day.

Costs for developing a six-inch plastic casing 120 foot well were estimated at $9.00 per foot. One test well was also charged at $3.00 per foot. The drawdown from continous pumping was estimated to be 50 feet at maximum.

The Water Development Bureau ran a preliminary survey of the proposed system to establish approximate location and elevation. From this survey it was determined that the well pump would have to produce a lift of 194 feet at a flow of 20 gallons per minute. One and one-half horsepower would be required for this lift and flow rate. It was assumed that three-phase power would be supplied to the pump site. Three-phase power is supplied by Fergus County Electric to approximately one-half mile from the proposed pump site.

A representative of Fergus County Electric indicated that the cost to run new line would be about $3,300 per mile. There is also a charge of $6.00 per horsepower per year for line use with a minumum charge of $60.00 per year. Total cost for a Goulds 1.5 Hp-three-phase motor and pump would be $566.50. An electric panel would also be required at the pump for a cost of $83.00.

Ronald Fiske who owns the land on which the well would be drilled and the pump site located would grant right-of-way across his property in return for installation of an automatic stock watering tank to service 100 head of cattle. Cost for the tank would be $160. Two hundred feet of two-inch pipe to locate the tank far enough away from the well to protect against contamination would cost $380.00 (2 inch PVC @ $1.90/foot installed). Coulee Hill Ranch owns the land on which the storage tank would be located. One member of the corporation was contacted and although he could not make the final decision on behalf of the corporation, he did not feel there would be any cost for right-of-way across their property. Any other right-of-way costs other than those mentioned were not included in this cost estimate.

Concrete costs for all concrete pump house were based on a 10 x 10 x 8 foot structure. About 10 cubic yards of concrete would be required at $34.00 per cubic yard and $1.50 per mile from Roundup (45 miles). Labor was charged at union scale and forms are rental.

Due to the rockiness of the soil on the bench above the coulee it was assumed that the first 4,650 feet of excavation would require

a backhoe. The average cost for backhoe trenching and backfilling in the area is 60¢ per linear foot.

A storage tank would be installed at the top of the rims with a capacity for two days household supply. Based on Golden Valley County Extension Agent, Darryld Kautzmann's estimates this would be about 6,500 gallons. For our cost estimate an 8,000 gallon steel storage tank was used. The cost of this tank would be about $3,500. The reason for a two day supply would be to insure water for household use in case of pump, motor or power failure which could hopefully be repaired in two days. An insulated metal storage shed (15 feet x 15 feet) set on a concrete base to house the storage tank would cost $20.00 per square foot for a total of $4,500.00. A 2,000 watt electric heater to maintain the temperature of the water above freezing could be obtained for $70.00. A chlorination unit and filter which could be installed on the inlet side of the tank or at the pump would cost $500.00. Operating costs of this unit would be minimal.

From the storage tank site to the bottom of the rims, excavation will have to be by blasting. There would be approximately 300 feet of blasting required at a cost of $10.00 per linear foot. Excavation through the remainder of the coulee could be accomplished with a trenching machine. The total length of trenching required would be 61,420 feet. Costs for this were calculated at a conservative 45¢ per foot. Trenching costs in the area for small jobs are 50¢ to 60¢ per foot. A reliable firm estimated that a large amount of trenching such as this could be done for 30¢ to 40¢ per foot.

The pipe line distribution system for the project was designed to provide gravity flow from the storage tank at 15 gallons per minute and minimum pressure of 50 pounds per square inch to twelve users. The users included in this design are J. Zinne, M. Schanz, T. Pitsch, E. Zinne, R.Schanz, A.Zinne, J. Schanz, E. Schaff, C. Schaff, R. Pitsch and C.T. Schaff. Some of the persons included on the system may not be interested at this time, but some allowance for increased use must be included in the design. Our preliminary survey did not include E. Zinne, T. Pitsch, R. Schanz and C.T. Schaff, so distances to these places and elevations were estimated. Polyvinyl Chloride (PVC) pipe would be used for the entire system. Pressure rating of this pipe would be 160 psi with a maximum burst pressure of 500 psi to handle any pressure surges in the system. Pipe sizes range from six inch to two inch and prices for the various sizes with solvent weld joints are as follows: two-inch -- 32¢, three-inch -- 70¢, four-inch -- $1.80, and six-inch -- $2.34 per foot. Total lengths of pipe required are 24,220 feet for two-inch, 18,750 feet for three-inch, 16,450 feet for four-inch, and 6,650 feet for six-inch.

The proposed system would intersect county roads at six locations. A backhoe would be required to dig the trench for an estimated 40 feet at each location. Two of the crossings are on the bench above the coulee where a backhoe will be required for all excavation, therefore the additional excavation for only four road crossings was included in the cost estimate. Each crossing will require a six-inch steel culvert to protect the plastic pipe from excessive stress due to traffic loads. Six, forty-foot,

16 gauge culverts were included in the cost estiamte at $2.50 per foot.

Pipe fittings costs were based on the estimated number of fittings required. Pipe fittings that would be required include; water meters at each place of use and one at the storage tank, reducers at each pipe diameter change, a tee at each branch off the system, manholes (8 foot sections of six-inch corrugated metal pipe) at all valves, gate valves at each branch and two at the tank, one check valve at the pump, pressure reducers at each user location, air-vaccuum relief valves at each major elevation peak and pressure relief valves at each major elevation drop and one at both ends of the system. An itemized cost for fittings is included in Table 1 on page 8 and 9.

Labor for installing the pipe was broken down from an installed pipe price for the purpose of illustrating the cost savings that would be incurred if the users were to install their own pipe under the supervision of one or two on-site inspectors from the company supplying the pipe or from the consulting firm completing the final design. Labor costs per linear foot were calculated at a rate of 58¢ for two-inch, 70¢ for three-inch, 72¢ for four-inch, and $1.16 for six-inch.

Final design, contract administration and project inspection costs were estimated by a consulting firm based on the total cost of construction.

## TABLE 1

## CONSTRUCTION COST SUMMARY

| | |
|---|---|
| WELL DEVELOPMENT | |
| 120 ft. well with 6 in plastic casing @ $9.00 per linear ft. | $ 1,080.00 |
| 200 ft. test well @ $3.00 per linear ft. | 600.00 |
| Subtotal | $ 1,680.00 |
| PUMP SITE | |
| 3 phase power line-0.5 mi. @ 3,300/mi. | $ 1,650.00 |
| 1.5 Hp pump and motor | 566.50 |
| Electric power panel-3 phase | 83.00 |
| Pump house-10 cubic yds. concrete @ $34.00/ cubic yds. | 340.00 |
| Delivery-45 mi. @ $1.50.mi. | 67.50 |
| Forms | 79.00 |
| Labor-16 hrs. @ $6.93/hr. | 111.00 |
| Subtotal | $ 2,897.00 |
| EXCAVATION | |
| Backhoe-4,810 ft.@ 60¢/linear ft. | $ 2,886.00 |
| Trenching-61,260 ft. @ 45¢/linear ft. | 27,567.00 |
| Blasting-300 ft. @ $10.00/linear ft. | 3,000.00 |
| Subtotal | $ 33,453.00 |
| STORAGE SITE | |
| Tank-8,000 gallon, steel, 10 ft. high | $ 3,500.00 |
| Storage Shed-15 ft.x 15 ft. metal, insulated @ $20.00 per sq. ft. | 4,500.00 |
| Electric Heater | 70.00 |
| Clorination Unit | 500.00 |
| Subtotal | $ 8,570.00 |
| DISTRIBUTION SYSTEM -- PVC PIPE | |
| 24,220 ft. of 2 in. @ 32¢/ft. | $ 7,750.00 |
| 18,750 ft. of 3 in. @ 70¢/ft. | 13,125.00 |
| 16,450 ft. of 4 in. @ $1.08/ft. | 17,766.00 |
| 6.650 ft. of 6 in. @ $2.34/ft. | 15,561.00 |
| Subtotal | $ 54,202.00 |

PIPE FITTINGS

| | | |
|---|---|---|
| Water meters | | |
| (12) 0.75 in. @ $150.00 each | $ | 1,800.00 |
| (1) 6 in. @ $310.00 each | | 310.00 |
| Reducers | | |
| (2) 6 in. to 4 in. @ $12.42 each | | 25.00 |
| (5) 4 in. to 3 in. @ $5.16 each | | 26.00 |
| (5) 3 in. to 2 in. @ $2.26 each | | 12.00 |
| Gate Valves | | |
| (1) 6 in. @ $200.00 each | | 200.00 |
| (1) 4 in. @ $133.56 each | | 134.00 |
| (2) 3 in. @ $59.31 each | | 119.00 |
| (12) 2 in. @ $21.41 each | | 257.00 |
| Tees | | |
| (1) 6 in. @ $50.52 each | | 51.00 |
| (4) 4 in. @ $28.19 each | | 113.00 |
| (5) 3 in. @ $24.79 each | | 124.00 |
| (2) 2 in. @ $19.41 each | | 39.00 |
| Check Valve (2) 2 in. @ $28.92 each | | 58.00 |
| Pressure Reducing Valves-(12) ½ in. @ $12.49 each | | 150.00 |
| Air Vacuum Relief Valves | | |
| (5) 4 in. @ $131.15 each | | 656.00 |
| (5) 2 in. @ $18.61 each | | 93.00 |
| Pressure Relief Valves | | |
| (5) 4 in. @ $85.80 each | | 429.00 |
| (5) 2 in. @ $25.00 each | | 173.00 |
| Manholes, (36) @ $25.00 each | | 900.00 |
| Subtotal | $ | 5,669.00 |

ROAD CROSSINGS

| | | |
|---|---|---|
| (6) 6 in. diameter, 40 ft. culverts-240 ft. @ $2.50/linear ft. | $ | 600.00 |
| Backhoe Excavation-(4) 40 ft. lengths @ 60¢ / linear ft. (included under excavation) | | 96.00 |
| Subtotal | $ | 696.00 |

INSTALLATION

| | | |
|---|---|---|
| 2 in. pipe-24,220 ft. @ 58¢/linear ft. | $ | 14,048.00 |
| 3 in. pipe-18,750 ft. @ 70¢/linear ft. | | 13,125.00 |
| 4 in. pipe-16,450 ft. @ 72¢/linear ft. | | 11,844.00 |
| 6 in. pipe-6,650 ft. @ $1.16/linear ft. | | 7,714.00 |
| Subtotal | $ | 46,731.00 |

RIGHT-OF-WAY

| | | |
|---|---|---|
| Pipe installed to tank; 200 ft. @ $1.90 per linear ft. | $ | 380.00 |
| Automatic Stock Waterer | | 160.00 |
| Subtotal | $ | 540.00 |

| | | |
|---|---|---|
| FINAL DESIGN, CONTRACT ADMINISTRATION AND INSPECTION | $ | 20,000.00 |
| TOTAL CONSTRUCTION COSTS | $ | 174,342.00 |

## Financial Analysis

Assuming the total cost of the project to be $174,342.00 at 5% interest over a 40 year period, the annual payment would be $10,160.65. With 12 users, this would be a monthly payment of $70.56 per user. Assuming the 1.5 Hp. pump will be operated continuously at full load and that electric current rate is 3¢ per kilowatt hour, the monthly power cost would be $31.10 per month. This would be $2.59 per user per month. The total monthly payment per user would be $73.15. This payment would not include maintenance or replacement costs for components of the system. A reserve account should be set up to cover costs of periodic maintenance, repair and replacement.

## Environmental Impacts

The proposed project is not expected to cause any significant environmental impacts in the area. For a short period of time during construction, streams and runoff will carry sediment dislodged by trenching operations. This may reoccur to a lesser extent during maintenance but the effect will be a temporary condition. All disturbed sites should be sloped to match the surrounding terrain and then seeded with native grasses. Increased water use may result in greater quantities of waste water than present septic systems can adequately treat, causing local pollution of ground water unless inadequate systems are replaced. Only a small amount of water is purchased from the city of Ryegate at the present time, therefore the proposed system will not significantly affect the city of Ryegate. If the proposed

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system is installed, the users will have good quality water readily avaiable for homes, gardens and lawns.

## Alternatives

There are four basic alternatives available to the Big Coulee residents as solution to their water supply problems:

1. Maintain present method of obtaining water.
2. Development of centralized rural water system as discussed in this report.
3. Develop the well as proposed and deliver water with tank truck.
4. Purchase a tank truck and obtain water from Ryegate.

The following will present the results of assessment of each of the alternatives.

### Maintain Present Method of Obtaining Water

At present most users haul approximately 2,000 to 4,000 gallons of water each year from Ryegate for drinking purposes. This water costs $1.00 per 1,000 gallons, available from a two inch main in the town of Ryegate, approximately 8 to 12 miles from the users. Most users have an additional well or cistern system for other domestic water uses (washing, some animal, lawn or garden use). Typically this water is in short supply (two to three gpm or rain water) and is of poor quality for human consumption pruposes. Stock watering is accomplished through use of Big Coulee Creek, with some supplemental hauling done in low flow periods.

They procure the water through portable water tanks which are placed on farm vechiles, usually grain trucks. Although we made

no calculation of the cost to haul their own water, LeRoy Luft, Extension Service Economist in Bozeman estimated hauling costs to be $58.50 per month. 1/ These estimates assume that a truck and tank would be used full time for hauling and therefore would be higher than the situation in Big Coulee.

Nonetheless, there is a definite cost incurred in actual hauling of the water, plus operating and maintenance costs attributable to the truck and tank, together with substantial labor time.

### Development of Centralized Rural Water System as Discussed In This Report

The distinct advantange of this alternative is the availability of a constant water source for drinking, washing, cooking, gardens, lawns, domestic and livestock uses. By having a central system, associated costs and labor with hauling could be avoided, plus allowing fresh water to be available to the farms.

The estimated cost of the system is $74.00 per month per household for 40 years. This is substantially higher than the present water supply expenses.

### Develop the Well as Proposed and Deliver Water With a Tank Truck

This alternative would involve developing the well discussed for alternative (2), saving the expense and time of driving to Ryegate.

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1/ Preliminary Study and Report for Proposed Tiber Water Users System, HKM Consulting Engineers, 1973, p. 12.

Additionally, this alternative looked at the option of purchasing a tank truck to haul water for the entire coulee, The largest capacity tank truck available for use in the valley would be a 12,000 gallon semi, which would cost approximately $41,000 to $42,000. Assuming that the repayment period could be seven years at 10% interest, it would cost $8,421.63 per year or $58.58 per month per user. In addition, operating and maintennace costs need to be added, including labor and diesel to run the truck, which would be quite significant to insure an adequate water supply.

To offer water availability better than present systems, the truck would need to be operated at an almost constant schedule (to supply lawn, garden or livestock uses). Given that the truck takes three hours to fill and that one and one-half hour is needed to empty the truck, labor costs could be prohibitive, unless users could switch driving days.

The contradiction of this alternative is that to be effectively used, a tank truck should be used to allow fresher water at a constant rate. This involves substantial labor and operation and maintenance costs, which in addition to the truck costs make this alternative the most expensive (notwithstanding the costs to develop and operate a seperate well).

Purchase a Tank Truck and Obtain Water From Ryegate

Essentially this is the same as number (3) above, with increased driving distance and operation and maintenance costs involved. The water costs will vary depending upon the amount purchased.

## Conclusions and Recommendations

Alternatives number (3) and (4) are economically unfeasible, given the expenses presented under alternative number (2). Alternative number (2) is less costly, plus it allows subtantially greater water use with less labor involved. Alternative number (1) is the least expensive, allowing for use of rain water, low capacity wells, Big Coulee Creek and water hauling throughout the year.

At present, the proposed domestic water system is estimated to cost approximately $74.00 per month for 40 years. Given economic conditions, this is a substantial fixed cost to incur each month. However, Ted Hebnes, at the State Farm Home Administration office in Bozeman, suggested the possibility of grant monies up to 50% of the project costs, secured from the Federal Government. If some assistance could be obtained the system could prove to be quite feasible. At this point the Big Coulee residents should pursue the availability of matching funds with Ted Hebnes at the FHA. If these are available, then intensive design and organizational steps could begin.

Additionally a Water Permit will be required from the Montana Department of Natural Resources and Conservation, and the system design should be approved by the Montana Department of Health and Environmental Sciences.

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BIG COULEE RURAL WATER SYSTEM GENERAL LOCATION MAP